SECTION 501
LIME-TREATED SOIL

501-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, treating the subgrade, embankment, natural ground or existing pavement structure by adding water and lime in the form specified herein, mixing, shaping, compacting and finishing the mixture to the required density. Prepare the soil layer to be stabilized; haul, proportion, spread and mix the materials within the depth range as shown on plans; manipulate, compact and finish the lime-treated soil; correct, repair and maintain the lime-treated soil; and apply a sand seal in accordance with the requirements of Article 501-3. Construct the work in accordance with the typical sections, lines and grades shown on the plan.

501-2 MATERIALS

Refer to Division 10.

Item	Section
Lime	1052-3
Water	1024-4

Use soil material which consists of material upon which the pavement is to be placed, existing material upon which the embankment is to be placed, approved borrow material or a combination of these materials proportioned as directed. Remove all vegetation, roots or other objectionable matter from the soil, as well as all aggregate or stone larger than 2" for the full depth to be treated.

501-3 LIMITATIONS

Do not perform lime stabilization when the air temperature is below 45°F. Do not mix the lime with frozen soils or when the soils contain frost. Apply lime to such areas as can be initially mixed and sealed during the day of application. Do not apply lime when wind conditions are such that blowing lime becomes hazardous to traffic, workers or adjacent property owners or when excessive loss of lime may occur.

Do not construct lime-treated soil that will not be covered with a layer of pavement or base by December 1 of that same calendar year. The Engineer may suspend the lime stabilization operations in writing when he determines that the Contractor will not cover the completed stabilization by December 1 as specified above.

Failure of the Contractor to cover the lime-treated soil as required will result in the Engineer notifying the Contractor in writing to cover the lime-treated soil with a sand seal. Apply the sand seal in accordance with Section 660, except Articles 660-3 and 660-11 will not apply. If the Contractor fails to apply the sand seal within 72 hours after receipt of such notice, the Engineer may proceed to have such work performed by other forces and equipment. The application of the sand seal by the Contractor or other forces will in no way relieve the Contractor of the responsibility to maintain or repair the damaged stabilization, no matter what the cause of damage, at no cost to the Department.

501-4 EQUIPMENT

(A) General

Use any combination of machines and equipment to produce the required results that meet the approval of the Engineer. Correct any leakage of fluids or materials promptly or the Engineer may order such equipment removed and replaced with satisfactory equipment. Comply with Article 107-21 with respect to operation of equipment and prevent damage to the base while applying water, curing seal and blotting sand.

(B) Lime Spreaders

Spread lime at the required rate by methods and equipment, which have been approved.

(C) Water Distribution Equipment

Add water to the soil with a pressure distributor or other suitable equipment capable of uniformly distributing the required amount.

(D) Mixers

Perform mixing with a self-propelled rotary mixer, except that disc harrows, motor graders and other equipment may be used only to supplement the mixing done by the rotary mixer.

Use mixing equipment capable of mixing to a compacted depth of at least 10".

(E) Compaction Equipment

Use compaction equipment that is self-propelled. Perform finish rolling with a pneumatic tired roller, or as permitted, a smooth, steel-wheel roller or a combination of both types.

(F) Scarifying Equipment

Use a grader-scarifier for the initial scarification of the soil. Use equipment capable of scarifying to the full depth of the stabilized treatment. When required, use a weeder, spiketooth harrow or nail drag, followed by a broom drag to scarify during finishing operations.

501-5 PROTECTION AND SAFETY

Take necessary precautions to protect personnel from dust created by the lime application and mixing operation to include eye protection, dust masks and appropriate training.

501-6 PREPARATION OF ROADBED

Before the addition of any lime to the soil, grade and shape the area to be stabilized in accordance with the typical sections, lines and grades shown on the plans. Remove all materials such as aggregate larger than 2", roots and turf.

501-7 SCARIFYING

When required by the method of application, scarify the soil to the required depth and width and then partially pulverize by making one pass through the area with a pulverizing rotary mixer. Delete the pulverizing portion of the scarifying operation in areas where the soil types or conditions make pulverizing with a rotary mixer impractical.

501-8 APPLICATION OF LIME

(A) General

When the Contractor has brought the soil layer to the elevation required by the plans, the Engineer will sample the soil and determine the quantity of lime to be incorporated. Allow 24 calendar days for the Engineer to perform the required sampling, testing and final design of the lime stabilization. The optimum moisture will be determined by the Engineer.

Spread lime or lime slurry only on an area of such size that all primary mixing operations can be completed in the same day during daylight hours, except where the work is to be done at night as required by the contract.

Incorporate the lime or lime slurry into the soil mixture at the rates determined by the Engineer. Distribute the lime at the uniform rate and minimize the scattering by the wind. Mix the lime into the soil within 2 hours after application.

No equipment, except that used in spreading, slaking and mixing, will be allowed to pass over the freshly spread lime until it is mixed with the soil.

(B) Slurry Method

Do not add lime slurry to the soil when the moisture content exceeds 2% above optimum moisture. Aerate soil or allow to dry naturally until the soil contains no more than 2% above optimum moisture.

Mix hydrated lime applied by this method with water in approved agitating equipment and apply to the soil to be treated as a thin water suspension or slurry. When quicklime is used to produce the slurry, use equipment specifically manufactured for the slaking of quicklime. Use distributing equipment that provides continuous agitation of the slurry from the slurry production site until the slurry is applied to the soil. Proportion the lime so that the dry solids content is at least 30% by weight.

Split the lime application into approximately 2 equal applications with the first being partially mixed into the soil to a minimum depth of 3" before applying the second application.

(C) Quicklime

Do not add dry quicklime to the soil when the moisture content exceeds 4% above optimum moisture. Aerate soil or allow to dry naturally until it contains no more than 4% above optimum moisture.

Where the “Bottom-Dump” method of application is used, omit the preliminary scarification of the soil surface. Apply the quicklime by slowly driving the tanker truck over the coverage area with the bottom discharge valves open creating a windrow of quicklime.

Repeat the process until the tanker is empty in order to provide at least 3, for a 24 ft roadway, reasonably uniform and equally spaced windrows over the area being stabilized. The number of windrows required will depend on the width of the section being stabilized and will be stipulated by the Engineer.

Carefully spread the windrows of quicklime with a motor grader into an equal depth layer over the entire area to be stabilized.

After the lime has been spread, follow with a sprinkling of water to slake the lime. After a complete slaking of the lime, thoroughly mix the lime with the soil. The Engineer may direct that the lime first be mixed into the soil followed by sprinkling and additional mixing to ensure complete slaking of the lime throughout the layer to be stabilized.

(D) Hydrated Lime

Use hydrated lime only with written permission and do not add to the soil when the moisture content exceeds 6% above optimum moisture.

501-9 MIXING

(A) Primary Mixing

Immediately after the lime has been spread and slaked, if required, mix the lime into the soil for the full depth of treatment. Mix the lime into the soil to provide a compacted depth of at least 8". A minimum number of mixing passes will be required to ensure uniform incorporation of the lime. Add water as necessary and thoroughly mix with the soil lime mixture so that the mixture contains no less than optimum moisture. A tolerance of 3% above optimum will be allowed. Incorporate all of the lime thoroughly and uniformly into the soil layer to the full depth of treatment so that the result is a homogeneous, friable mixture of soil and lime, free of clods or lumps exceeding 2" in size.

After primary mixing operations and before curing, shape and lightly compact the lime-treated area to the approximate section to allow for proper drainage and to minimize evaporation loss.

(B) Preliminary Curing

Following primary mixing operations, cure the stabilized layer for 1 to 4 days. The actual duration of this curing period will be determined by the Engineer. During the curing period, keep the surface of the material moist to prevent drying and cracking and maintain in a properly sealed and crowned condition. Mix, compact, shape and finish the stabilized layer no later than 4 days after primary mixing.

(C) Final Mixing and Pulverizing

Immediately after the completion of the preliminary curing period, mix and pulverize completely the stabilized layer to the full depth of the stabilization. Continue the final mixing until all of the clods are broken down to pass a 1/2" sieve and at least 80% pass a No. 4 sieve, exclusive of rock. Add water, as required, during the final mixing to raise the moisture content before compaction.

501-10 COMPACTING, SHAPING AND FINISHING

Begin compaction of the mixture immediately after completion of the final mixing operations. Aerate or moisten the mixture as necessary during compaction operations to maintain the moisture between optimum and optimum plus 2%. Compact the full depth of the mixture to a density equal to at least 97% of that obtained by compacting a sample of the soil lime mixture in accordance with AASHTO T 99 as modified by the Department. Copies of these modified procedures are available upon request from Materials and Tests Unit. Accompany the compaction with sufficient blading to eliminate irregularities.

Perform the final rolling of the completed surface with a pneumatic-tired roller or if permitted a smooth, steel-wheel roller.

Complete shaping, final mixing, compacting and finishing on the same day upon completion of the preliminary curing. This work is to be completed no later than 4 days after primary mixing and done during daylight hours, unless otherwise provided in the contract. If the above work is not completed as specified, rip up the entire section and add additional lime, as directed, at no additional cost to the Department.

501-11 THICKNESS

The compacted thickness of the completed treated soil layer will be determined by measurements made in test holes located at random intervals not to exceed 500 ft. Do not deviate the measured thickness from that shown on the plans by more than plus 1" or minus 1/2".

Where the lime-treated soil layer is deficient in thickness by more than 1/2", remove and replace the area of deficient thickness with lime-treated soil having the required thickness at no cost to the Department.

As an exception to the above, if the deficiency is not considered sufficient to seriously impair the required strength of the lime-treated soil layer, the deficient area may, at the discretion of the Engineer, be left in place.

501-12 FINAL CURING

After the lime-treated soil has been finished in accordance with Article 501-10, protect it against drying for a 7 day curing period in accordance with Section 543.

501-13 TRAFFIC

Completed sections of the lime-treated soil may be opened when necessary to lightweight local traffic, provided it has hardened sufficiently to prevent marring or distorting of the surface and provided the curing is not impaired. Do not use construction equipment on the lime-treated soil, except as necessary to discharge material into the spreader during paving operations or except as may be otherwise permitted for embankment construction.

501-14 MAINTENANCE

Maintain the lime-treated soil in an acceptable condition until final acceptance of the project. Include immediate repair of any defects or damage in maintenance operations. Repeat as necessary to keep the lime-treated soil in an acceptable condition. Perform repairs to lime-treated soil by replacing the lime-treated soil for its full depth rather than by adding a thin layer of lime stabilized material to the existing layer. An alternate repair method may be used if approved in writing.

501-15 MEASUREMENT AND PAYMENT

Lime-Treated Soil will be measured and paid as the number of square yards of each layer of lime-treated soil that has been completed and accepted. In determining this quantity, the width of the lime-treated soil will be measured across the top surface of the treated layer. The length will be the actual length constructed, measured along the centerline of the surface of the treated layer.

Lime for Lime-Treated Soil where hydrated lime or quick lime is spread directly on the soil in solid form or when hydrated lime is used to produce a slurry, the quantity of lime to be paid will be the number of tons of lime that has been incorporated into the soil at the required rates. No measurement will be made of any lime added or replaced for corrective measures during construction or for repairing damaged areas. Measurement is to be made in bulk in the truck on certified platform scales or other certified weighting devices.

Where quicklime is slaked on the project and applied in slurry form, measurement will be calculated as indicated below for each truckload using the certified lime purity for that load.

A+B = Total hydrated lime produced (pay quantity)

Where:

A = Certified weight of quicklime delivered x % purity x 1.32
B = Certified weight of quicklime delivered x % inert material

Asphalt Curing Seal will be paid in accordance with Article 543-5.

Blotting Sand will be paid in accordance with Article 818-4.

If a layer of lime-treated soil is deficient in thickness but has been permitted to be left in place in accordance with Article 501-11, payment for that lime-treated soil and lime will be made at 50% of the contract unit prices for *Lime-Treated Soil* and *Lime for Lime-Treated Soil*.

Sand seal applied due to the failure of the Contractor to cover the lime-treated soil as required will be incidental to the work of this section. If the Contractor fails to provide sand seal as required and the Engineer has the work performed by other forces, the cost of such work will be deducted from monies due or to become due to the Contractor.

Maintenance, repair and restoration of the lime stabilization is incidental to the work of this section.

Payment will be made under:

Pay Item	Pay Unit
Lime-Treated Soil	Square Yard
Lime for Lime-Treated Soil	Ton